ADEQ Arizona Department of Environmental Quality

Memorandum

Date: [DATE \@ "MMMM d, yyyy"]
To: Patsy Arias, TMDL Unit
From: Patti Spindler, SWMS Unit
Thru: Steve Pawlowski, SWMS Manager
Subject: Queen Creek biological investigation, Part II

Purpose and sites monitored

A hydrological and biological investigation of Queen Creek was conducted on April 19th, 2005 by Patsy Arias, and biologists Samuel Rector and Patti Spindler. The purpose of this investigation was to determine the extent of surface water and the relative permanence of the water in Queen Creek from the headwater downstream to the wastewater treatment plant discharge point. A biological and hydrological evaluation was conducted at three reaches of Queen Creek, and a hydrological analysis was conducted at an additional two reaches of Queen Creek (Table 1). Photos and notes of flowing water at other points in the Queen Creek channel were also noted (see Sam Rector's notes).

Table 1. Queen Creek locations that were investigated on April 19th, 2005.

Queen Creek reach description	Investigation conducted
Headwater, upstream of mine	Hydrological (Field parameters & water sample)
Downstream of unnamed tributary from Oak Flat reservoir	Hydrological (Field parameters & water sample)
Downstream of Superior Tank	Hydrological & biological
Upstream of BHP discharge point	Hydrological & biological
Downstream of BHP discharge point	Hydrological & biological

Methods

The biological evaluation consisted of field observations of aquatic and riparian life and collection of macroinvertebrate samples. A habitat evaluation which included observations about channel substrate conditions and riparian corridor conditions was also conducted along with the biological evaluation. More information about biological sampling methods can be found in the Biocriteria Quality Assurance Program Plan (ADEQ, 2005). The hydrological evaluation consisted of collection of field parameters in flowing riffle/run segments and collection of a water sample for chemical analysis.

Results

Biological indicators of semi-permanent to permanent water

The biological evaluation of three reaches of Queen Creek revealed that there are long-lived aquatic fauna which indicate a constant source of water. There were long-lived insects, tadpoles and sunfish found among the three sites (Table 2). Univoltine (1 year life cycle) insects such as stoneflies of the Capniidae and Taeniopterygidae families were found at the Superior tank site. Semi-voltine (>1 year life cycle) Dytiscidae beetles were found at all the sites and the dobsonfly *Neohermes* was present in kick samples from the Superior Tank site and the site downstream of the BHP discharge location. In addition, several sunfish were found in a large pool in the site upstream of the BHP discharge and tadpoles were found in the site downstream of the BHP discharge. These are long-lived organisms which require, at a minimum, permanent pools of water for survival.

Queen Creek is an intermittently flowing stream, with some perennial segments and pools. There are abundant biological indicators of long lived species living in different segments of Queen Creek. In addition, there was ample flow and deep pools in several locations along the channel during this late date in April, when no recent precipitation has occurred. An ephemeral stream is a surface water that has a channel that is at all times above the water table and that flows only in direct response to precipitation, as per the definition in the Arizona Surface Water Quality Standards. Queen Creek is clearly not an ephemeral stream from the headwaters to the Superior WWTP because it does not flow *only* in response to precipitation events and because it has many biological indicators which provide evidence of long term water in the stream.

Another indicator of available water is the lush riparian corridor from Superior Tank to below the discharge point. Many phreatophytes, such as cottonwood, sycamore and willow trees, will only propagate when there is sufficient surface flow to allow seed germination in wetted bar features. The presence of riparian vegetation in the study reach and upstream suggest a continuing source of water.

Table 2. Biological indicators of semi-permanent to permanent water found at Queen Creek sites.

Queen Creek reach description	Aquatic fauna present	Vegetation indicators
Downstream of Superior Tank	Stoneflies, mayflies, hellgrammites, beetles, midges, black fly larvae	Velvet Ash, Arizona Sycamore, Fremont Cottonwood, Gooding Willow, Southwestern Chokecherry
Upstream of BHP discharge point	Mayflies, beetle larvae, dipteran larvae, black flies, blood midges, Sunfish	Velvet Ash, Tamarisk, Mesquite
Downstream of BHP discharge point	Helgrammites, mayflies, Dytiscidae and other beetle larvae, black flies, amphipods, tadpoles	Velvet Ash, Tamarisk, Gooding Willow, Mesquite

Macroinvertebrate Index of Biological Integrity (IBI) scores

Macroinvertebrate taxonomy and abundance data was analyzed using ADEQ's warmwater Index of Biological Integrity. Macroinvertebrate metrics and the Index were calculated and are presented in Table 3. Overall the IBI scores for all the Queen Creek samples were low, falling in the impaired range, with three metrics lacking values (caddisfly taxa richness, scraper taxa, and %scrapers). The QCAMP2 sample from below the mine discharge contained nearly twice as many taxa as the upstream QCAMP1 site, presumably due to more permanent water. There were several univoltine beetles present and 3 moderately to highly tolerant multi-voltine mayfly taxa present at CQAMP2. While there were several more species present here, there were no scrapers, and no caddisflies. At the QC below Superior Tank site, there were two winter stonefly taxa found. The IBI score was very low at this site as well, with a score of 26. Again the lack of scrapers and caddisflies caused the score to fall in the impaired range.

Though the IBI scores for all the Queen Creek samples were low, falling in the impaired range, there were a range of long lived insects present including mayflies, stoneflies, beetles and diptera which indicate that aquatic life is indeed present year-round in Queen Creek.

The lack of caddisflies and taxa of the algae-scraping feeding group at these sampling sites may be occurring as a result of a lag time in recovering from several years of drought conditions. A lag effect in recovering populations of macroinvertebrates, including caddisflies after drought conditions in intermittent streams has been documented (Boulton, 2003). The caddisfly *Hydroptila* was found in the spring 1998 sample, so we would expect that there are colonizing sources, such as perennial pools of water, from which to re-establish this population in the study reach. The reason for the lack of scrapers in Queen Creek is unknown, but it is not due to lack of habitat or lack of diatoms. We documented thick coatings of diatom biofilms on cobbles in the study reach this spring 2005, which provides an ample food source and habitat for scrapers.

Table 3. Index of Biological Integrity scores for macroinvertebrate samples from Queen Creek, April 2005.

Metric	QC blw Superior Tank		QCAMP2		QCAMP1	
	Metric Value	Metric Score	Metric Value	Metric Score	Metric Value	Metric Score
Total Taxa	14	41	20	58.8	12	35.3
Trichoptera Taxa	0	0	0	0	0	0
Ephemeroptera taxa	1	14	3	43	1	14.3
Diptera taxa	6	66.7	9	100	6	66.7
Scraper taxa	0	0	0	0	0	0
Percent Scrapers	0	0	0	0	0	0
Percent Ephemeroptera	0.36	0.5	13.2	18.6	0.51	0.72
Percent Dominant Taxon	71.6	36	43	72	47	66
HBI	6.04	78	5.88	81	6.13	76
Estimated total abundance of entire sample*	8912		2525		2352	
Warmwater IBI Score		26.2		41.5		28.8

* Samples were subsampled to a count of 500. Total abundance estimates were obtained by multiplying by the subsample fraction.

Citations:

ADEQ. 2005. Biocriteria Program Quality Assurance Program Plan. Arizona Department of Environmental Quality, Rev. B. Phoenix, AZ.

Boulton, A.J. 2003. Parallels and contrasts in the effects of drought on stream macroinvertebrate assemblages. Freshwater Biology 48 (7):1173-1185.